

**Notice of Allowability**

Application No.

09/317,124

Applicant(s)

HINTON SR. ET AL.

Examiner

Art Unit

Kambiz Zand

2132

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to Appeal brief filed on 08/02/2004 & interview conducted on 07/13/2005.
2. ☒ The allowed claim(s) is/are 3-4, 16-17, 23, 27-28, 38-41, 43-44, 49-56, 63-66, 70, 84, 86-88, 91-94, 98, 100, 102, 106, 111-112, 118-122, 128-129, 137-139, 143, 151, 157 and 159, now re-numbered as claims 1-54.
3. ☒ The drawings filed on 27 February 2001 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some\* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

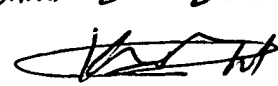
\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_\_.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08),  
Paper No./Mail Date 07/29/2004
4. ☐ Examiner's Comment Regarding Requirement for Deposit  
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413),  
Paper No./Mail Date 07/13/05 enclosed.
7. ☒ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_\_

Kambiz Zand  


**DETAILED ACTION**  
**EXAMINER'S AMENDMENT**

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mr. Bradley C. Wright (Registration number 38,061) on 07/13/2005 (please see the enclosed interview summary). Examiner amendments are as follow:

**Claims 1-2:**

Cancelled.

**Claim 3:**

(Currently Amended) A method of transmitting information, comprising the steps of:

(1) generating a chaotic carrier signal that causes a voltage to oscillate chaotically about a first equilibrium point in a current-voltage phase space of a circuit that exhibits a current-voltage characteristic curve on which the first equilibrium point falls; and

(2) changing, in response to an information signal, a non-reactive resistive value in the circuit and thereby causing the first equilibrium point to shift

to a shifted first equilibrium point in the current-voltage phase space. [The method of claim 1,]

wherein the circuit exhibits a piecewise-linear current-voltage characteristic comprising three linear segments, two of the linear segments having a first slope in the phase space and the third linear segment having a second slope in the phase space; and wherein step (2) comprises the step of changing either the first slope or the second slope but not both slopes in response to the information signal.

**Claim 4:**

(Currently Amended) A method of transmitting information, comprising the steps  
of:

(1) generating a chaotic carrier signal that causes a voltage to oscillate chaotically about a first equilibrium point in a current-voltage phase space of a circuit that exhibits a current-voltage characteristic curve on which the first equilibrium point falls; and

(2) changing, in response to an information signal, a non-reactive resistive value in the circuit and thereby causing the first equilibrium point to shift to a shifted first equilibrium point in the current-voltage phase space. [The method of claim 1,]

wherein the circuit exhibits a piecewise-linear current-voltage characteristic comprising three linear segments, two of the linear segments having a first slope in the phase space and the third linear segment having a second slope in the phase space; and wherein step (2) comprises the step of changing both the first slope and the second slope in response to the information signal.

**Claims 5-15:**

Canceled.

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**Claim 16:**

(Currently Amended) A chaotic transmitting circuit, comprising:

an oscillator circuit;

a resistor coupled to the oscillator circuit;

a chaotic circuit, coupled to the oscillator circuit through the resistor, wherein the chaotic circuit exhibits a current-voltage characteristic shape having a slope that intersects a load line defined by the resistor and provides an equilibrium point about which a voltage oscillates chaotically; and

means for changing the slope exhibited by the chaotic circuit in accordance with an information signal, [The chaotic transmitting circuit according to claim 15,]

wherein the oscillator circuit comprises an inductance and a first capacitance;

wherein the chaotic circuit comprises a second capacitance; and

wherein the values of the first capacitance, the second capacitance, the inductance, and the resistance are selected so as to cause the chaotic transmitting circuit to oscillate in a single-scroll attractor mode.

**Claim 17:**

(Currently Amended) A chaotic transmitting circuit, comprising:

an oscillator circuit;

a resistor coupled to the oscillator circuit;

a chaotic circuit, coupled to the oscillator circuit through the resistor, wherein the chaotic circuit exhibits a current-voltage characteristic shape having a slope that intersects a load line defined by the resistor and provides an equilibrium point about which a voltage oscillates chaotically; and

means for changing the slope exhibited by the chaotic circuit in accordance with an information signal, [The chaotic transmitting circuit according to claim 15,]

wherein the oscillator circuit comprises an inductance and a first capacitance;

wherein the chaotic circuit comprises a second capacitance; and

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wherein the values of the first capacitance, the second capacitance, the inductance, and the resistance are selected so as to cause the chaotic transmitting circuit to oscillate in a double-scroll attractor mode.

**Claims 18-22:**

Canceled.

**Claim 23:**

(Currently Amended) A chaotic transmitting circuit, comprising:

an oscillator circuit;

a resistor coupled to the oscillator circuit;

a chaotic circuit, coupled to the oscillator circuit through the resistor, wherein the chaotic circuit exhibits a current-voltage characteristic shape having a slope that intersects a load line defined by the resistor and provides an equilibrium point about which a voltage oscillates chaotically; and

means for changing the slope exhibited by the chaotic circuit in accordance with an information signal. [The chaotic transmitting circuit according to claim 22,]

wherein the chaotic circuit comprises circuit elements having values selected so as to cause the chaotic transmitting circuit to oscillate about a single-scroll attractor,

wherein the means for switching shifts an equilibrium point of the single-scroll attractor among at least three different positions on the current-voltage characteristic shape, each position corresponding to a different information symbol contained in the information signal.

**Claims 24-26:**

Canceled.

**Claim 27:**

(Currently Amended) A chaotic transmitting circuit, comprising:

an oscillator circuit;

a resistor coupled to the oscillator circuit;

a chaotic circuit coupled to the oscillator circuit through the resistor, wherein the chaotic circuit exhibits a current-voltage characteristic shape having a slope that intersects a load line defined by the resistor and provides an equilibrium point about which a voltage oscillates chaotically; and

a switch coupled to the chaotic circuit, wherein the switch changes a nonreactive resistive value in the chaotic circuit in accordance with an information signal and thereby causes the first equilibrium point to shift to a shifted first equilibrium point, [The chaotic transmitting circuit of claim 25,]

wherein the chaotic circuit comprises:

a first op amp coupled across the oscillator circuit through the resistor, wherein the first op amp is further coupled to a first group of three resistors, a first of which is coupled between an output of the first op amp and a positive input terminal thereof; a second of which is coupled between the output of the first op amp and a negative input terminal thereof; and a third of which is coupled between the negative input terminal and a ground; and

a second op amp coupled across the oscillator circuit through the resistor, wherein the second op amp is further coupled to a second group of three resistors, a first of which is coupled between an output of the second op amp and a positive input terminal thereof; a second of which is coupled between the output of the second op amp and a negative input terminal thereof; and a third of which is coupled between the negative input terminal and the ground.

**Claims 29-37:**

Cancelled.

**Claim 42:**

Canceled.

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**Claim 43:**

(Currently Amended) A chaotic receiver comprising:

an input terminal that receives a modulated chaotic signal;

an oscillator coupled to the input terminal;

a chaotic circuit comprising a capacitor and a negative resistance circuit;

a gain control amplifier coupled between the oscillator and the chaotic circuit,

wherein the gain control amplifier amplifies a voltage present at the oscillator before it reaches the chaotic circuit;

a synchronizing resistor coupled between the input terminal and the chaotic circuit; and

a detection circuit, coupled to the synchronizing resistor, wherein the detection circuit detects periods of synchronization and non-synchronization between the modulated chaotic signal and the chaotic circuit and generates an output corresponding to periods of synchronization and non-synchronization, [The chaotic receiver of claim 42,]

wherein the gain control amplifier provides an amplification of between 2.4 dB to 3 dB.

**Claims 45-48:**

Canceled.

**Claim 49:**

(Currently Amended) A chaotic transmitter, comprising:

an oscillator;

a resistor coupled to the oscillator;

a chaotic circuit comprising a negative resistance, wherein the chaotic circuit is coupled to the oscillator circuit through the resistor;

an isolation amplifier coupled to the chaotic circuit;

a filter coupled to the output of the isolation amplifier that limits a frequency bandwidth present at the chaotic circuit; and

means for modulating a circuit element of the chaotic transmitter in accordance with an information signal, [The chaotic transmitter of claim 45,]

wherein the means for modulating comprises a switch that switches a reactive component in the oscillator, thereby changing a strange attractor trajectory generated by the transmitter.

**Claim 50:**

(Currently Amended) A chaotic transmitter, comprising:

an oscillator;

a resistor coupled to the oscillator;

a chaotic circuit comprising a negative resistance, wherein the chaotic circuit is coupled to the oscillator circuit through the resistor;

an isolation amplifier coupled to the chaotic circuit;

a filter coupled to the output of the isolation amplifier that limits a frequency bandwidth present at the chaotic circuit; and

means for modulating a circuit element of the chaotic transmitter in accordance with an information signal, [The chaotic transmitter of claim 45,]

wherein the means for modulating comprises a switch that switches a reactive component in the chaotic circuit, thereby changing a strange attractor trajectory generated by the transmitter.

**Claim 51:**

51. (Currently Amended) A chaotic transmitter, comprising:

an oscillator;

a resistor coupled to the oscillator;

a chaotic circuit comprising a negative resistance, wherein the chaotic circuit is coupled to the oscillator circuit through the resistor;

an isolation amplifier coupled to the chaotic circuit;

a filter coupled to the output of the isolation amplifier that limits a frequency bandwidth present at the chaotic circuit; and

means for modulating a circuit element of the chaotic transmitter in accordance with an information signal, [The chaotic transmitter of claim 45,]

wherein the means for modulating comprises a switch that changes a non-reactive resistive value in the chaotic circuit, thereby changing a current-voltage characteristic of the negative resistive element.

**Claims 57-62:**

Canceled.

**Claim 63:**

(Currently Amended) A chaotic telephone device comprising:

a chaotic transmitter that receives a first information signal and generates in response thereto a first chaotic trajectory shifted signal modulated in accordance with the first information signal;

a chaotic receiver that receives a second chaotic trajectory shifted signal modulated in accordance with a second information signal and generates in response thereto a demodulated version of the second chaotic trajectory shifted signal; and

an interface circuit that couples the chaotic transmitter and chaotic receiver to a radio-frequency telephone circuit, wherein the radio-frequency telephone circuit communicates with a ground-based telephone network through one or more radio frequency transmission stations, [The chaotic telephone device of claim 57,]

wherein the chaotic transmitter modulates using a first set of strange attractor parameters that match a set of strange attractor parameters in a corresponding receiver associated with the one or more radio frequency transmission stations; and wherein the chaotic receiver demodulates using a second set of strange attractor parameters in a corresponding transmitter associated with the one or more radio frequency transmission stations.

**Claim 64:**

(Currently Amended) A chaotic telephone device comprising:

a chaotic transmitter that receives a first information signal and generates in response thereto a first chaotic trajectory shifted signal modulated in accordance with the first information signal;

a chaotic receiver that receives a second chaotic trajectory shifted signal modulated in accordance with a second information signal and generates in response thereto a demodulated version of the second chaotic trajectory shifted signal; and

an interface circuit that couples the chaotic transmitter and chaotic receiver to a radio-frequency telephone circuit, wherein the radio-frequency telephone circuit communicates with a ground-based telephone network through one or more radio frequency transmission stations, [The chaotic telephone device of claim 57,]

wherein the chaotic receiver comprises:

an oscillator;

a chaotic circuit comprising a circuit element that exhibits a nonlinear current-voltage characteristic; and

a gain control amplifier coupled between the oscillator and the chaotic circuit, wherein the gain control amplifier amplifies a voltage present at the oscillator before it reaches the chaotic circuit.

**Claim 65:**

(Currently Amended) A chaotic telephone device comprising:

a chaotic transmitter that receives a first information signal and generates in response thereto a first chaotic trajectory shifted signal modulated in accordance with the first information signal;

a chaotic receiver that receives a second chaotic trajectory shifted signal modulated in accordance with a second information signal and generates in response thereto a demodulated version of the second chaotic trajectory shifted signal; and

an interface circuit that couples the chaotic transmitter and chaotic receiver to a radio-frequency telephone circuit, wherein the radio-frequency telephone circuit communicates with a ground-based telephone network through one or more radio frequency transmission stations, [The chaotic telephone device of claim 64,]

wherein the chaotic receiver further comprises a synchronizing resistor coupled between an input of the chaotic receiver and the chaotic circuit; and

further comprising a detection circuit, coupled to the synchronizing resistor, wherein the detection circuit detects periods of synchronization and non-synchronization between the second modulated chaotic signal and the chaotic circuit and generates an output corresponding to periods of synchronization and non-synchronization.

**Claim 66:**

(Currently Amended) A chaotic telephone device comprising:

a chaotic transmitter that receives a first information signal and generates in response thereto a first chaotic trajectory shifted signal modulated in accordance with the first information signal;

a chaotic receiver that receives a second chaotic trajectory shifted signal modulated in accordance with a second information signal and generates in response thereto a demodulated version of the second chaotic trajectory shifted signal; and

an interface circuit that couples the chaotic transmitter and chaotic receiver to a radio-frequency telephone circuit, wherein the radio-frequency telephone circuit communicates with a ground-based telephone network through one or more radio frequency transmission stations, [the chaotic telephone device of claim 57,]

wherein the chaotic transmitter comprises:

an oscillator circuit;

a resistor coupled to the oscillator circuit;

a chaotic circuit comprising a circuit element that exhibits a nonlinear current-voltage characteristic, wherein the chaotic circuit is coupled to the oscillator circuit through the resistor;

an isolation amplifier coupled to the chaotic circuit;

a filter coupled to the output of the isolation amplifier that limits a frequency bandwidth present at the chaotic circuit; and

means for modulating a circuit element of the chaotic transmitter in accordance with the first information signal.

**Claims 67-69:**

Canceled.

**Claim 70:**

(Currently Amended) A method of communicating between a portable telephone device and a base station, comprising the steps of:

- (1) generating an information signal at the portable telephone device;
- (2) modulating a chaotic carrier signal with the information signal using a chaotic trajectory shifting technique;
- (3) transmitting the chaotic trajectory shift-keyed signal generated in step (2) to the base station; and
- (4) in the base station, demodulating the transmitted signal to recover the information signal. [The method of claim 67,]

wherein step (2) comprises the step of using a nonlinear circuit element that exhibits a piecewise linear current-voltage characteristic comprising three linear segments, two of the segments having a first slope in the phase space and the third segment having a second slope in the phase space, and where step (2) comprises the step of changing either the first slope or the second slope but not both slopes in response to the information signal.

**Claims 71-83:**

Canceled.

**Claim 84:**

(Currently Amended) A chaotic receiver, comprising:  
an input terminal that receives a modulated chaotic signal;  
an oscillator circuit coupled to the input terminal;

a first chaotic circuit coupled to the oscillator circuit and tuned to a first strange attractor;

a second chaotic circuit coupled to the oscillator circuit and tuned to a second strange attractor; and

means for detecting a difference between the modulated chaotic signal received at the input terminal and respective signals generated by the first and second chaotic circuits. [The chaotic receiver of claim 83,]

further comprising a third chaotic circuit coupled to the oscillator circuit and tuned to a third strange attractor; wherein the means for detecting a difference further detects a difference between the modulated chaotic signal received at the input terminal and a signal generated by the third chaotic circuit.

**Claim 85:**

Canceled.

**Claim 86:**

(Currently Amended) A method of demodulating a signal modulated according to a chaotic trajectory shift-keying technique, comprising the steps of:

(1) receiving a modulated chaotic signal modulated according to a chaotic trajectory shift-keying technique;

(2) using the modulated chaotic signal to drive an oscillator;

(3) using the modulated chaotic signal and an output of the oscillator to drive a first chaotic circuit tuned to a first strange attractor;

(4) using the modulated chaotic signal and an output of the oscillator circuit to drive a second chaotic circuit tuned to a second strange attractor; and

(5) detecting a difference between the modulated chaotic signal and respective signals generated by the first and second chaotic circuits. [The method of claim 85,]

further comprising the step of using the modulated chaotic signal and an output of the oscillator circuit to drive a third chaotic circuit tuned to a third strange attractor,

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and wherein step (5) comprises the step of detecting a difference between the modulated chaotic signal and a signal generated by the third chaotic circuit.

**Claim 87:**

(Currently Amended) A chaotic receiver, comprising:

an input terminal that receives a modulated chaotic signal;

an oscillator circuit coupled to the input terminal;

a first chaotic circuit coupled to the oscillator circuit and tuned to a first strange attractor;

a second chaotic circuit coupled to the oscillator circuit and tuned to a second strange attractor; and

means for detecting a difference between the modulated chaotic signal received at the input terminal and respective signals generated by the first and second chaotic circuits. [The receiver of claim 83,]

wherein the means for detecting comprises:

a plurality of synchronizing resistors each of which generates a voltage drop in response to a difference between the modulated chaotic signal and a corresponding one of the first and second chaotic circuits;

means for buffering the plurality of synchronizing resistors and generating buffered outputs therefrom;

means for attenuating the buffered outputs; and

means for subtracting the buffered outputs to generate a detected signal.

**Claim 88:**

(Currently Amended) A method of demodulating a signal modulated according to a chaotic trajectory shift-keying technique, comprising the steps of:

(1) receiving a modulated chaotic signal modulated according to a chaotic trajectory shift-keying technique;

(2) using the modulated chaotic signal to drive an oscillator;

(3) using the modulated chaotic signal and an output of the oscillator to drive a first chaotic circuit tuned to a first strange attractor;

(4) using the modulated chaotic signal and an output of the oscillator circuit to drive a second chaotic circuit tuned to a second strange attractor; and

(5) detecting a difference between the modulated chaotic signal and respective signals generated by the first and second chaotic circuits, [The method of claim 85,]

wherein step (5) comprises the steps of:

(a) generating a voltage drop in response to a difference between the modulated chaotic signal and a corresponding one of the first and second chaotic circuits;

(b) buffering the plurality of synchronizing resistors and generating buffered outputs therefrom;

(c) attenuating the buffered outputs; and

(d) subtracting the buffered outputs to generate a detected signal.

**Claims 89-90:**

Canceled.

**Claim 91:**

(Currently Amended) A chaotic receiver, comprising:

an input terminal that receives a modulated chaotic signal;

an oscillator circuit coupled to the input terminal;

a first chaotic circuit coupled to the oscillator circuit and tuned to a first strange attractor;

a second chaotic circuit coupled to the oscillator circuit and tuned to a second strange attractor; and

means for detecting a difference between the modulated chaotic signal received at the input terminal and respective signals generated by the first and second chaotic circuits, [The chaotic receiver of claim 83,]

wherein the means for detecting a difference comprises at least two synchronizing resistors, each respectively coupled between the oscillator and one of the first and second chaotic circuits, the chaotic receiver further comprising:

first and second subtractor circuits, each coupled across a corresponding one of the two synchronizing resistors;

a third subtractor circuit, coupled to the first and second subtractor circuits, wherein the third subtractor circuit generates a difference signal from the first and second subtractor circuits;

an absolute value circuit, coupled to the third subtractor circuit, which generates an absolute value signal from the third subtractor circuit; and

a squaring circuit that generates a squared version of the absolute value signal.

**Claim 92:**

(Currently Amended) A method of demodulating a signal modulated according to a chaotic trajectory shift-keying technique, comprising the steps of:

(1) receiving a modulated chaotic signal modulated according to a chaotic trajectory shift-keying technique;

(2) using the modulated chaotic signal to drive an oscillator;

(3) using the modulated chaotic signal and an output of the oscillator to drive a first chaotic circuit tuned to a first strange attractor;

(4) using the modulated chaotic signal and an output of the oscillator circuit to drive a second chaotic circuit tuned to a second strange attractor; and

(5) detecting a difference between the modulated chaotic signal and respective signals generated by the first and second chaotic circuits. [The method of claim 85,]

wherein step (5) comprises the step of generating a voltage drop in response to a difference between the modulated chaotic signal and a corresponding one of the first and second chaotic circuits, the method further comprising the steps of:

- (6) generating first and second difference signals corresponding to first and second voltage drops from the first and second chaotic circuits;
- (7) subtracting the first and second difference signals and generating a third difference signal therefrom;
- (9) generating an absolute value signal from the third difference signal;
- and
- (10) generating a squared version of the absolute value signal.

**Claim 93:**

(Currently Amended) A chaotic receiver, comprising:

an input terminal that receives a modulated chaotic signal;

an oscillator circuit coupled to the input terminal;

a first chaotic circuit coupled to the oscillator circuit and tuned to a first strange attractor;

a second chaotic circuit coupled to the oscillator circuit and tuned to a second strange attractor; and

means for detecting a difference between the modulated chaotic signal received at the input terminal and respective signals generated by the first and second chaotic circuits. [The chaotic receiver of claim 83,]

wherein the means for detecting a difference comprises at least two synchronizing resistors, each respectively coupled between the oscillator and one of the first and second chaotic circuits, the chaotic receiver further comprising:

first and second subtractor circuits, each coupled across a corresponding one of the two synchronizing resistors;

first and second absolute value circuits, each coupled to a corresponding one of the first and second subtractor circuits;

a third subtractor circuit, coupled to the first and second absolute value circuits, which generates a subtracted absolute value signal; and

a squaring circuit that generates a squared version of the subtracted absolute value signal.

**Claim 94:**

(Currently Amended) A method of demodulating a signal modulated according to a chaotic trajectory shift-keying technique, comprising the steps of:

(1) receiving a modulated chaotic signal modulated according to a chaotic trajectory shift-keying technique;

(2) using the modulated chaotic signal to drive an oscillator;

(3) using the modulated chaotic signal and an output of the oscillator to drive a first chaotic circuit tuned to a first strange attractor;

(4) using the modulated chaotic signal and an output of the oscillator circuit to drive a second chaotic circuit tuned to a second strange attractor; and

(5) detecting a difference between the modulated chaotic signal and respective signals generated by the first and second chaotic circuits, [The method of claim 85,]

wherein step (5) comprises the step of generating a voltage drop in response to a difference between the modulated chaotic signal and a corresponding one of the first and second chaotic circuits, the method further comprising the steps of:

(6) generating first and second difference signals corresponding to first and second voltage drops from the first and second chaotic circuits;

(7) generating first and second absolute value signals from the first and second difference signals;

(8) subtracting the first and second first and second absolute value signals and generating therefrom a subtracted absolute value signal; and

(9) generating a squared version of the subtracted absolute value signal.

**Claims 95-97:**

Canceled.

**Claim 98:**

(Currently Amended) A method of transmitting information, comprising the steps of:

(1) generating a chaotic carrier signal that causes a voltage to oscillate chaotically about a first equilibrium point in a current-voltage phase space of a circuit that exhibits a current-voltage characteristic curve on which the first equilibrium point falls; and

(2) changing, in response to an information signal, a non-reactive resistive value in the circuit and thereby causing the first equilibrium point to shift to a shifted first equilibrium point in the current-voltage phase space, [The method of claim 1,]

wherein step (2) comprises the step of changing the non-reactive resistive value to one of a plurality of uniquely coded vectors within a chaotic operating region which, when received at a matched receiver, will generate a corresponding unique code.

**Claim 99:**

Canceled.

**Claim 100:**

(Currently Amended) A chaotic transmitting circuit, comprising:  
an oscillator circuit;

a resistor coupled to the oscillator circuit;

a chaotic circuit, coupled to the oscillator circuit through the resistor, wherein the chaotic circuit exhibits a current-voltage characteristic shape having a slope that intersects a load line defined by the resistor and provides an equilibrium point about which a voltage oscillates chaotically; and

means for changing the slope exhibited by the chaotic circuit in accordance with an information signal, [the apparatus of claim 15,]

wherein the means for changing sets the non-reactive resistive value to one of a plurality of uniquely coded vectors within a chaotic operating region which, when received at a matched receiver, will generate a corresponding unique code.

**Claim 101:**

Canceled.

**Claim 102:**

(Currently Amended) A chaotic transmitting circuit, comprising:

an oscillator circuit;

a resistor coupled to the oscillator circuit;

a chaotic circuit coupled to the oscillator circuit through the resistor, wherein the chaotic circuit exhibits a current-voltage characteristic shape having a slope that intersects a load line defined by the resistor and provides an equilibrium point about which a voltage oscillates chaotically; and

a switch coupled to the chaotic circuit, wherein the switch changes a nonreactive resistive value in the chaotic circuit in accordance with an information signal and thereby causes the first equilibrium point to shift to a shifted first equilibrium point, [The apparatus of claim 25,]

wherein the switch sets the non-reactive resistive value to one of a plurality of uniquely coded vectors within a chaotic operating region which, when received at a matched receiver, will generate a corresponding unique code.

**Claims 103-105:**

Canceled.

**Claim 106:**

(Currently Amended) A method of transmitting information, comprising the steps of:

(1) in response to receiving a time-varying N-bit code representing a unit of information, selecting a corresponding one of a plurality of  $2^N$  transmitters each of which generates a chaotic strange attractor signal that is distinct from others in the plurality of  $2^N$  transmitters;

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(2) transmitting through a communications channel the chaotic strange attractor signal selected in step (1); [(plus reception method, DEH/CPG) The method of claim 103, further comprising the steps of:]

- (3) receiving the chaotic strange attractor signal transmitted in step (2);
- (4) matching the signal received in step (3) to one of a plurality of  $2^N$  receivers each of which is matched to a corresponding one of the plurality of  $2^N$  transmitters; and
- (5) on the basis of the receiver matched in step (4), recovering the N-bit code received in step (1).

**Claim 107-110:**

Canceled.

**Claim 112:**

(Currently Amended) A system comprising:

a transmitting system capable of transmitting N bits of information, comprising:

a plurality of  $2^N$  transmitters each of which generates a chaotic strange attractor signal that is distinct from others in the plurality of  $2^N$  transmitters;

a switch which, in response to receiving a time-varying N-bit code representing a unit of information, selects a corresponding one of the plurality of  $2^N$  transmitters; and

a transmission circuit that transmits the selected chaotic strange attractor signal across a transmission channel, and [An information transmission system comprising a transmitting system according to claim 110 and]

a receiving system, comprising: [wherein the receiving system comprises:]

a receiving circuit that receives a time-varying signal comprising a plurality of discrete portions of each of a plurality of chaotic strange attractor signals;

a plurality of  $2^N$  receivers each of which is tuned to one of the  $2^N$  transmitters;

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a plurality of detectors each of which detects whether a corresponding one of the plurality of  $2^N$  receivers has received a matching signal; and

a switching circuit which, in response to one of the detectors detecting a corresponding match, generates an N-bit code representing a transmitted unit of information.

**Claims 113-117:**

Canceled.

**Claim 118:**(Currently Amended) A chaotic receiver comprising:an input terminal that receives a modulated chaotic signal;an oscillator circuit coupled to the input terminal and driven by the modulated chaotic signal;a chaotic circuit comprising an upper slope circuit that implements a first current-voltage function in an upper quadrant of a current-voltage response plane and a lower slope circuit that implements a second current-voltage function in a lower quadrant of the current-voltage response plane, wherein the first and second current-voltage functions have a different voltage offset, and wherein the upper and lower slope circuits cooperate with the oscillator circuit to generate a local chaotic signal;a synchronizing circuit, coupled to the oscillator circuit and the chaotic circuit, wherein the synchronizing circuit detects differences between the modulated chaotic signal at the input terminal and the local chaotic signal;a detector coupled to the synchronizing circuit which detects periods of synchronization and non-synchronization; [The chaotic receiver of claim 116, further comprising:]

a first analog-to-digital converter coupled to the oscillator circuit;

a second analog-to-digital converter coupled to the upper slope circuit; and

a third analog-to-digital converter coupled to the lower slope circuit;

wherein the detector detects periods of synchronization and non-synchronization with respect to the output of each of the first, second, and third analog-to-digital converters.

**Claim 119:**

(Currently Amended) A chaotic receiver comprising:

an input terminal that receives a modulated chaotic signal;

an oscillator circuit coupled to the input terminal and driven by the modulated chaotic signal;

a chaotic circuit comprising an upper slope circuit that implements a first current-voltage function in an upper quadrant of a current-voltage response plane and a lower slope circuit that implements a second current-voltage function in a lower quadrant of the current-voltage response plane, wherein the first and second current-voltage functions have a different voltage offset, and wherein the upper and lower slope circuits cooperate with the oscillator circuit to generate a local chaotic signal;

a synchronizing circuit, coupled to the oscillator circuit and the chaotic circuit, wherein the synchronizing circuit detects differences between the modulated chaotic signal at the input terminal and the local chaotic signal;

a detector coupled to the synchronizing circuit which detects periods of synchronization and non-synchronization; [The chaotic receiver of claim 116, further comprising:]

a first filter, coupled between the input terminal and the oscillator circuit, wherein the first filter filters the modulated chaotic signal and produces a filtered modulated chaotic signal;

a second filter, coupled to a first portion of the synchronizing circuit, wherein the second filter filters a buffered version of the filtered modulated chaotic signal; and

a third filter, coupled to a second portion of the synchronizing circuit, wherein the third filter filters a signal generated by the chaotic circuit; and

wherein the detector is coupled to respective outputs of the second and third filters.

**Claim 120:**

(Currently Amended) A chaotic receiver comprising:

an input terminal that receives a modulated chaotic signal;

an oscillator circuit coupled to the input terminal and driven by the modulated chaotic signal;

a chaotic circuit comprising an upper slope circuit that implements a first current-voltage function in an upper quadrant of a current-voltage response plane and a lower slope circuit that implements a second current-voltage function in a lower quadrant of the current-voltage response plane, wherein the first and second current-voltage functions have a different voltage offset, and wherein the upper and lower slope circuits cooperate with the oscillator circuit to generate a local chaotic signal;

a synchronizing circuit, coupled to the oscillator circuit and the chaotic circuit, wherein the synchronizing circuit detects differences between the modulated chaotic signal at the input terminal and the local chaotic signal;

a detector coupled to the synchronizing circuit which detects periods of synchronization and non-synchronization; [The chaotic receiver of claim 116, further comprising:]

a first filter, coupled between the input terminal and the synchronizing circuit, wherein the first filter filters the modulated chaotic signal and produces a filtered modulated chaotic signal;

a second filter, coupled to a first portion of the synchronizing circuit, wherein the second filter filters a buffered version of the filtered modulated chaotic signal; and

a third filter, coupled to a second portion of the synchronizing circuit, wherein the third filter filters a signal generated by the chaotic circuit; and

wherein the detector is coupled to respective outputs of the second and third filters.

**Claim 121:**

(Currently Amended) A chaotic receiver comprising:

an input terminal that receives a modulated chaotic signal;

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an oscillator circuit coupled to the input terminal and driven by the modulated chaotic signal;

a chaotic circuit comprising an upper slope circuit that implements a first current-voltage function in an upper quadrant of a current-voltage response plane and a lower slope circuit that implements a second current-voltage function in a lower quadrant of the current-voltage response plane, wherein the first and second current-voltage functions have a different voltage offset, and wherein the upper and lower slope circuits cooperate with the oscillator circuit to generate a local chaotic signal;

a synchronizing circuit, coupled to the oscillator circuit and the chaotic circuit, wherein the synchronizing circuit detects differences between the modulated chaotic signal at the input terminal and the local chaotic signal;

a detector coupled to the synchronizing circuit which detects periods of synchronization and non-synchronization; [The chaotic receiver of claim 116, further comprising:]

a first filter, coupled between the input terminal and the oscillator circuit, wherein the first filter filters the modulated chaotic signal and produces a filtered modulated chaotic signal;

a second filter coupled between the chaotic circuit and the oscillating circuit;

a third filter, coupled to an output of the first filter, which further filters the output of the first filter;

wherein the synchronizing circuit is coupled between the third filter and the chaotic circuit, and wherein the synchronizing circuit generates a voltage difference in response to an out-of-synchronization condition between a signal from the third filter and the chaotic circuit;

a fourth filter, coupled to a first portion of the synchronizing circuit, which filters a buffered version of the filtered modulated chaotic signal; and

a fifth filter, coupled to a second portion of the synchronizing circuit, which filters a signal generated by the chaotic circuit;

wherein the detection circuit is coupled to respective outputs of the fourth and fifth filters.

**Claim 122:**

(Currently Amended) A chaotic receiver comprising:

an input terminal that receives a modulated chaotic signal;

an oscillator circuit coupled to the input terminal and driven by the modulated chaotic signal;

a chaotic circuit comprising an upper slope circuit that implements a first current-voltage function in an upper quadrant of a current-voltage response plane and a lower slope circuit that implements a second current-voltage function in a lower quadrant of the current-voltage response plane, wherein the first and second current-voltage functions have a different voltage offset, and wherein the upper and lower slope circuits cooperate with the oscillator circuit to generate a local chaotic signal;

a synchronizing circuit, coupled to the oscillator circuit and the chaotic circuit, wherein the synchronizing circuit detects differences between the modulated chaotic signal at the input terminal and the local chaotic signal; and

a detector coupled to the synchronizing circuit which detects periods of synchronization and non-synchronization; [The apparatus of claim 116,]

wherein the upper slope circuit satisfies the relation  $I = G_bV + G_aV_{bp} - G_bV_{bp}$ ; wherein the lower slope circuit satisfies the relation  $I = G_bV - G_aV_{bp} + G_bV_b$ , where  $I$  is the current through each respective slope circuit,  $G_b$  is a first slope constant,  $V$  is the voltage across the respective slope circuit,  $G_a$  is a second slope constant, and  $V_{bp}$  is a breakpoint voltage.

**Claims 123-127:**

Canceled.

**Claim 128:**

(Currently Amended) A chaotic transmitter, comprising:

a first chaotic circuit that generates a first chaotic signal having a first strange attractor trajectory;

a second chaotic circuit that generates a second chaotic signal having a second strange attractor trajectory different from that of the first strange attractor trajectory;

a switch coupled to the first and second chaotic circuits, wherein the switch selects either the first chaotic signal or the second chaotic signal in response to an information signal; and

a low-pass filter coupled to the output of the switch [The apparatus of claim 75,]

wherein the first chaotic circuit exhibits a first current slope that is offset to intersect a load line in an upper quadrant of a current-voltage characteristic curve; and wherein the second chaotic circuit exhibits a second current slope that is offset to intersect the load line in a lower quadrant of the current-voltage characteristic curve.

**Claim 129:**

(Currently Amended) A method of transmitting an information signal, comprising the steps of:

(1) generating a first chaotic signal comprising at least one strange attractor that oscillates about a first equilibrium point;

(2) generating a second chaotic signal comprising at least a second strange attractor that oscillates about a second equilibrium point;

(3) in response to the information signal, selecting an output of either the first chaotic signal or the second chaotic signal; and

(4) transmitting the selected output from step (3). [The method of claim 79,]

wherein step (1) comprises the step of generating a first chaotic signal that oscillates about a first equilibrium point in an upper quadrant of a current-voltage phase space of a chaotic circuit element, and wherein step (2) comprises the step of generating a second chaotic signal that oscillates about a second equilibrium point in a lower quadrant of the current-voltage phase space.

**Claims 130-136:**

Canceled.

**Claim 140-142:**

Canceled.

**Claim 143:**

(Currently Amended) A chaotic transmitter, comprising:

a first chaotic circuit that generates a first chaotic signal having a first strange attractor trajectory;

a second chaotic circuit that generates a second chaotic signal having a second strange attractor trajectory different from that of the first strange attractor trajectory;

a switch coupled to the first and second chaotic circuits, wherein the switch selects either the first chaotic signal or the second chaotic signal in response to an information signal; and

a low-pass filter coupled to the output of the switch, [The apparatus of claim 75,]

wherein the first chaotic circuit exhibits a first positive linear current slope that is offset to intersect a load line in an upper quadrant of a current-voltage characteristic curve; and wherein the second chaotic circuit exhibits a second positive linear current slope that is offset to intersect the load line in a lower quadrant of the current-voltage characteristic curve.

**Claims 144-150:**

Canceled.

**Claim 151:**

(Currently Amended) A method of interfacing a chaotic transmitting circuit to a communications channel without using a frequency filter, comprising the steps of:

(1) buffering an output of the chaotic transmitting circuit to isolate the chaotic transmitting circuit from the communications channel;

(2) removing a direct current voltage component from the buffered output obtained in step (1); and

(3) matching the amplitude and impedance of the signal obtained from step (2) to the communications channel, [The method of claim 148,]

wherein step (3) comprises the step of matching the amplitude and impedance of the signal obtained from step (2) to a light emitting diode.

**Claims 152-156:**

Canceled.

**Claim 157:**

(Currently Amended) A method of interfacing a chaotic receiving circuit to a communications channel without using a frequency filter, comprising the steps of:

(1) buffering a modulated chaotic signal received from the communications channel to isolate the chaotic receiving circuit from the communications channel;

(2) amplifying the buffered signal; and

(3) adding a direct current component to the amplified buffered signal obtained in step (2), wherein the direct current component corresponds to a direct current component subtracted at a corresponding transmitter, [The method of claim 156,]

further comprising the step of, prior to step (1), passing the modulated chaotic signal through a balanced input buffer/amplifier that matches electrical characteristics of a dual conductor communications channel to the chaotic receiving circuit.

**Claim 158:**

Canceled.

**Claim 159:**

(Currently Amended) Apparatus for interfacing a chaotic receiving circuit to a communications channel without using a frequency filter, comprising:

a buffering circuit that buffers a modulated chaotic signal received from the communications channel to isolate the chaotic receiving circuit from the communications channel;

an amplifier coupled to the buffering circuit that amplifies an output of the buffering circuit; and

a direct current voltage offset circuit coupled to the amplifier, wherein the direct current voltage offset circuit adds a direct current component to the amplified buffered signal, wherein the direct current component corresponds to a direct current component subtracted at a corresponding transmitter, [The apparatus of claim 158,]

further comprising a differential input amplifier, coupled to the buffering circuit, wherein the differential input amplifier rejects common-mode input components and amplifies differential components.

2. The text of those sections of Title 35, U.S. Code not included in this section can be found in the prior office action.

3. The prior office actions are incorporated herein by reference. In particular, the observations with respect to claim language, and response to previously presented arguments.

4. Examiner withdraws rejection of claims 36-44, 54-109 and 111-159 under 35 U.S.C 112-First paragraphs due to arguments presented by the applicant in the Appeal brief dated 08/02/2004.
5. Examiner withdraws rejection of claims 36-44, 54-109 and 111-159 under 35 U.S.C 112-second paragraphs due to arguments presented by the applicant in the Appeal brief dated 08/02/2004.
6. Claims 1-2, 5-15, 18-22, 24-26, 29-37, 42, 45-48, 57-62, 67-69, 71-83, 85, 89, 90, 95-97, 99, 101, 103-105, 107-110, 113-117, 123-127, 130-136, 140-142, 144-150, 152-156 and 158 have been cancelled by Examiner amendment.
7. Claims 3-4, 16-17, 23, 27, 43, 49-52, 63-66, 70, 84, 86-88, 91-94, 98, 100, 102, 106, 111-112, 118-122, 128-129, 143, 151, 157 and 159 have been amended by Examiner amendment.
8. Claims 3-4, 16-17, 23, 27-28, 38-41, 43-44, 49-56, 63-66, 70, 84, 86-88, 91-94, 98, 100, 102, 106, 111-112, 118-122, 128-129, 137-139, 143, 151, 157 and 159, now re-numbered as claims 1-54 are pending.

***Response to Arguments***

9. Applicant's arguments filed 08/02/2004 and agreement reached on the interview conducted on 07/13/2005 have been fully considered and they are persuasive.

### **Allowable Subject Matter**

10. **Claims** 3-4, 16-17, 23, 27-28, 38-41, 43-44, 49-56, 63-66, 70, 84, 86-88, 91-94, 98, 100, 102, 106, 111-112, 118-122, 128-129, 137-139, 143, 151, 157 and 159 **are allowed.**

### **Conclusion**

11. Any comments considered necessary by the applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submission should be clearly labeled "comments on statement of reasons for allowance."

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kambiz Zand whose telephone number is (571) 272-3811. The examiner can normally be reached on Monday-Thursday (8:00-5:00). If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gilberto Barron can be reached on (571) 272-3799. The fax phone numbers for the organization where this application or proceeding is assigned is (571) 273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For

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more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Kambiz Zand', enclosed within a horizontal oval shape.

Kambiz Zand

07/18/2005

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